

## REMARKS

In this rejection, it appears that claim 63 has not been specifically addressed and as such remains unrejected. A further non-final office action to rectify this oversight is respectfully requested.

In light of the indication that claim 48 contains allowable subject matter, this claim has been amended to assume independent form and thus assumes a *prima facie* condition for allowance. The dependence of claim 53 on claim 48 is such as also place claim 53 in condition for allowance.

Claim 47 has been revised to improve syntax and form. The scope of this claim is deemed unchanged by these changes. This claim is submitted as being allowable over the cited art for at least the reasons advanced below.

A new claim 78 is presented for examination. Support for the subject matter presented in this claim is found in the specification when taken as a whole. This claim is deemed allowable for at least the reasons advanced in connection with claim 47.

The rejection of claims 47, 51-53, 58-62, 64-65, 67, 70-74 and 76-77 under 35 USC § 103(a) as being unpatentable over Kosek (US Patent Application 2003/0062268) in view of Narayanan (US Patent Application 2003/0226763) and evidenced by "Chemical Reaction" Britanica Online Encyclopedia, is respectfully traversed.

In the Office Action, the Examiner has asserted, in connection with claim 47, that Kosek discloses a hydrogen generating stack (paragraphs [0016] and [0034]) and comprises a membrane 18, an anode 16 ("fuel electrode") on one surface of the membrane 18, and a cathode 20 ("oxidizing electrode") on the other surface of the membrane 18 (see Figure 1; paragraph [0016])."

Referring to paragraph [0034] of Kosek, it is stated that "In still other alternative embodiments of the invention, a methanol/hydrogen stack may be used, in which methanol is oxidized

at the anode to produce protons, electrons and carbon dioxide, and hydrogen gas is evolved at an elevated pressure at the cathode by reduction of the protons with the elements."

Referring to this statement, a reaction occurs at:

anode (fuel electrode) with  $\text{CH}_3\text{OH} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 6\text{H}^+ + 6\text{e}^-$

cathode (oxidizing electrode) with  $6\text{H}^+ + 6\text{e}^- \rightarrow 3\text{H}_2$ ,

and hydrogen gas ( $\text{H}_2$ ) is generated from cathode (oxidizing electrode).

In paragraph [0017], it is stated that "a power conditioner 28 provides the power required for electrochemical hydrogen generation and compression." Thus, to generate hydrogen gas ( $\text{H}_2$ ) from the electrochemical reaction as mentioned above, the power conditioner 28 is used to provide the necessary amount of electrons ( $6\text{e}^-$ ) for the reaction of cathode mentioned above.

Then, this generated hydrogen gas ( $\text{H}_2$ ) is obtained (see Figure 1) from the cathode (oxidizing electrode).

On the other hand, as the instant specification states:

By the way, with regard to a DMFC using a proton conducting solid electrolyte membrane such as Nafion, there has been known a phenomenon called methanol crossover, that is, the crossover of methanol from the fuel electrode to the oxidizing electrode. Thus, it is possible that crossed methanol undergoes electrolytic oxidization represented by the following formula on the oxidizing electrode.

$\text{CH}_3\text{OH} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 6\text{H}^+ + 6\text{e}^-$  . . . . (3); (see paragraph [0146]),

The  $\text{H}^+$  (proton) produced as a result of the reaction represented by formula (3) migrates through the proton conducting solid electrolyte membrane to reach the fuel electrode to undergo there a reaction represented by the following formula to produce hydrogen.

$6\text{H}^+ + 6\text{e}^- \rightarrow 3\text{H}_2$  . . . . (4); (see paragraph [0148]),

As a result of crossover, to the subsidiary reaction where methanol permeating from the fuel electrode is oxidized by oxygen on the surface of catalyst coated on the air electrode as represented by the following formula.

$\text{CH}_3\text{OH} + 3/2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  . . . (6); (see paragraph [0157]), the supply of oxygen (air) is decreased, and when the open-circuit voltage is 300 to 800 mV, hydrogen evolves. However, this is probably because the oxidation of methanol permeated to the air electrode as represented by formula (6) is suppressed, evolution reaction of  $\text{H}^+$  as represented by formula (3) becomes dominant, and the  $\text{H}^+$  undergoes reaction represented by formula (4) to produce hydrogen; ([0159]).

In the invention (claim 47), the reaction occurs at:

cathode (oxidizing electrode) with  $\text{CH}_3\text{OH} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 6 \text{H}^+ + 6 \text{e}^-$ , and

anode (fuel electrode) with  $6 \text{H}^+ + 6 \text{e}^- \rightarrow 3 \text{H}_2$

and hydrogen gas ( $\text{H}_2$ ) is generated at the anode (fuel electrode).

Thus, to achieve the claimed invention, "a hydrogen generating device," providing "means for collecting the gas containing hydrogen" to the anode (fuel electrode) is important.

The purpose of the claimed invention is to acknowledge the generation of hydrogen from the anode (fuel electrode). In Kosek, generation of hydrogen from the cathode (oxidizing electrode) is shown, but the generation of hydrogen from the anode (fuel electrode) is not.

In addition, in the invention (claim 47), anode (fuel electrode) is "means for collecting the gas containing hydrogen" whereas Kosek provides that cathode (oxidizing electrode) is "means for collecting the gas containing hydrogen (GENERATED  $\text{H}_2$ ).". Therefore, "means for collecting the gas containing hydrogen" is provided in the opposite position.

Also, in claim 50, electric energy ( $e^-$ ) is provided from the outside, and  $H_2$  is generated, by a similar reaction of Kosek, but  $H_2$  is generated from the anode (fuel electrode), which is independent from the electric energy ( $e^-$ ) provided from the outside.

Thus, to use the "a hydrogen generating device," providing "means for collecting the gas containing hydrogen" to the anode (fuel electrode) is equally important as the invention of claim 47.

Also, the effect of the invention defined in claim 50 is stated in paragraph [0252] of specification as:

Relation of the rate of hydrogen evolution with the current density applied in the test is shown in Fig. 43. It was found that the efficiency of hydrogen evolution (efficiency of hydrogen evolution relative to electric energy supplied) becomes equal to or more than 100% (100% efficiency of hydrogen evolution is represented by the dashed line in Fig. 43) in certain areas when the current density is kept not more than  $40\text{mA}/\text{cm}^2$ . This suggests that it is possible to obtain hydrogen whose energy content is larger than the electric energy supplied from outside by operating the cell in those areas.

As the examiner pointed out that "Narayanan discloses a system in which a fuel cell 520 is supplied with hydrogen from an electrolyzer 100 and the electricity generated from fuel cell is supplied to an engine to power an electrically-driven vehicle", the electrolyzer 100 is similar to Kosek in that it uses the cathode (oxidizing electrode) to generate hydrogen ( $H_2$ ) and obtain the generated hydrogen from the cathode (oxidizing electrode) (see Fig. 1). Therefore, using the anode (fuel electrode) to generate and

obtain hydrogen is neither shown nor suggested. In fact, it can be looked upon as teaching the very reverse of what is claimed.

As explained *supra*, the claimed invention is not obvious in light of the disclosures of Kosek and Narayanan taken either individually or in combination.

The rejection of claim 68 under 35 USC § 103(a) as being unpatentable over Kosek (in view of Narayanan, evidenced by "Chemical Reaction" Britanica Online Encyclopedia, and further in view of Hsu, is respectfully traversed.

Hsu discloses an arrangement wherein the fuel cell 350 is typically designed to release fuel exhausts 315 to the interior 313 of the vessel 314 and that the exhaust can be collected "for recycling in reforming use or for other commercial feedstocks. Just what is meant by "commercial feedstocks" is not clear and, while recycling of air is suggested, this does not suggest a modification wherein the anode of Kosek would be rendered capable of generating hydrogen in place of the cathode.

The rejection of claim 69 under 35 USC § 103(a) as being unpatentable over Kosek (in view of Narayanan, evidenced by "Chemical Reaction" Britanica Online Encyclopedia, and further evidenced by Lehmann et al. (US 2002/0036147) is respectfully traversed.

In this rejection, it is submitted that the Kosek reference teaches that the disclosed electrolyzer used may be a sodium sulphate electrolyzer where sodium sulphate/sulphuric acid is supplied to the fuel electrode as fuel. Then, the Lehmann et al. reference, which is merely cited to "evidence" that hydrogen peroxide solution can migrate across a membrane, is such as to, irrespective of the fact that this reference is not being applied as a reference *per se*, induce the rejection to leap to the conclusion that this would be such that the "oxidizing agent"

supplied to the cathode in the electrolyzer of Kosek is a hydrogen peroxide solution.

It is respectfully submitted that this cannot be derived when using disclosure which is cited as evidence and is such as to transfer teachings there from and to conclude that substantial changes are suggested.

The rejection of claim 75 under 35 USC § 103(a) as being unpatentable over Kosek (in view of Narayanan, evidenced by "Chemical Reaction" Britanica Online Encyclopedia, and further in view of Moulthrop Jr. et al. (US 6,383,361), is respectfully traversed.

Moulthrop has been cited to suggest that carbon dioxide filtration could be used in the Kosek arrangement. However, there is only one sole reference to carbon dioxide in this reference. Viz., "Hydrogen or oxygen gases produced through electrolytic methods often contain: appreciable quantities of atmospheric gases, such as nitrogen, carbon dioxide, and argon . . . ." There is nothing else mentioned about carbon dioxide and although there is a discussion of trace contaminant ions and particles being removed from the water by an ion exchange resin and a filter, there is nothing sufficiently specific as to suggest that carbon dioxide is targeted or any suggestion as to the possibility of the disclosed catalyzed ion exchange resin performing a CO<sub>2</sub> removal function. Disclosure sufficient to lead the reader of ordinary skill to the conclusion upon which this rejection is based, is submitted as being absent.

The allowability of claim 47 for the reasons advanced *supra* are such as to also render the withdrawn claims 49-50 and 54-57, which depend directly or indirectly from claim 47, also allowable.

Favorable reconsideration and allowance of all claims is therefore courteously solicited.

One month extension of time is hereby requested. A credit card authorization form in the amount of \$130.00 is attached herewith for the one month extension of time.

Respectfully submitted,

**KANESAKA BERNER & PARTNERS**



Manabu Kanesaka  
Registration No. 31,467

1700 Diagonal Road, Suite 310  
Alexandria, Virginia 22314  
(703) 519-9785 MAN/yid  
Facsimile: (703) 519-7769